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(19)

(54) PROCESS FOR THE TREATMENT OF WASTE MATERIAL

(71) I, GEORG KROPFHAMMER of D 8221 Seebruck, Germany, a citizen of the Federal Republic of Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process for treating waste material, which in the present specification means domestic, agricultural or forestry waste materials, to produce building elements. In the process the waste materials are comminuted, at least partially dehydrated, optionally sterilised mixed with binders and finally compressed to form the building elements.

On such process is already known (Swiss Patent Specification 503,576). According to the latter, the waste materials are subjected to aerobic rotting to form an aerobic fermented substrate. The aerobic fermented substrate is then dehydrated to a water content of less than 10% and sterilised in order to form a dry fibre granulated material with a fine structure. The dry neutral, fibrous and odourless product is then mixed with wood chips and synthetic resin binders, while being stirred vigorously, and thereafter compressed in a press into sheet-like building elements. It is also known in this connection to admix dyestuffs, flame-proofing agents, insecticides and/or fungicides with the synthetic resin binder. However, the disadvantage of this process is that the waste can only be used in compost form after a comparatively long rotting period.

The invention has for its object to modify such a "refuse-exploiting process".

According to the present invention there is provided a process for the production of a building element from waste material as hereinbefore defined, in which the waste material is comminuted, mixed with a substance which in the mixture is alkaline, and at least partially dehydrated, and the decomposed material thus produced is mixed with a binder and compressed to form a building element.

Preferably, the waste material is mixed with the substance which is alkaline in the mixture after comminution. Preferably, the dehydration of the waste material is achieved by the use as the substance is alkaline in the mixture of a substance which has a dehydrating effect. It has been found that quicklime (CaO) more especially decomposes vegetable and animal waste, whereby it is possible to produce a considerable saving in time as compared with aerobic rotting. Furthermore, the nuisance caused by odour with occurs during a rotting operation is avoided. Furthermore, it is unnecessary to add bacteria to the rotting waste so as to accelerate the rotting operation. Composting installations already in existence can be used when carrying out the invention; it is merely desirable to exclude clarified sludge (bacteria), since the refuse is essentially treated according to the invention by decomposition processes and not aerobically.

The advantage of using quicklime consists firstly in that this material can be cheaply obtained. Furthermore, in the decomposition of the waste, there is automatically produced a disinfecting action with a deposit effect, the cause of which is the slaked lime ($Ca(OH)_2$) formed by the dehydrating action of the quicklime. Consequently, the introduction of additional sterilising or disinfecting agents may usually be avoided. Another important advantage of the calcium hydroxide consists in that its disinfecting action, by contrast with numerous other disinfecting agents, is substantially maintained. Finally, quicklime or slaked lime also has the effect of promoting setting as soon as the formed building elements are united or brought into contact

with other building materials, for example, cement, gypsum or like hydraulic binders.

It is advisable to add quicklime in excess, so that practically all the water in the waste material is combined and there are still available residues of quicklime, which residues themselves act as an additional binder with water which may be subsequently admixed, i.e. before pressing. If residues of quicklime are also still present in the building elements, this is available for assisting setting when the building elements are for example bonded with materials forming cement or motar. There is then established a particularly firm bond between the cement, mortar or like building material and the building element.

The substance acting in the mixture as an alkali, more particularly alkalis, destroy existing bacteria, with simultaneous extraction of water and smell, as a result of the conversion reaction taking place with the decomposition of the waste material. As a result, there is an automatic raising of the temperature which accelerates the process. Further acceleration is possible by supplying additional heat, which also assists in dehydrating the waste material. It is advisable constantly to take off moisture or other gases being formed, and this can for example be effected by constant ventilation in the bunker or hopper or in a rotary tube furnace.

The decomposed mixture is preferably sprayed with the binder while descending freely and in the loose state, so that the smallest possible conglomerates should be each at least partially covered with binder. Suitable as binders, in addition to hydraulic binders, are particularly epoxide resins, unsaturated polyester resins, polyurethane resins, phenol resins, aminoplast resins, acryl resins and polymer dispersions based on vinyl monomers and bitumen. By "epoxide resins" are understood, in the normal way, polyfunctional epoxide compounds in combination with the polycarboxylic acid anhydrydes and/or polyamines normally employed as hardeners. It is advisable for the mixture to be moistened prior to the mixing or spraying with, more particularly, dispersions as binders, and advantageously with water-confining surface-active substances.

Specific examples of carrying out a process within the invention will now be described with reference to the accompanying diagrammatic drawing.

Refuse stored in a refuse hopper 1 is first of all comminuted by means of bulk material shears 2 and thereafter in a coarse mill 3 down to particles having an average particle size of about 3 to 4 cm. The refuse is now transferred together with quicklime CaO supplied from the storage hopper 4 by way of a measuring balance 5 into a decomposition drum 6 and mixed, the decomposition and dehydration procedure taking place quickly in the drum, possibly with additional supply of heat and constant ventilation. After separating out waste materials which cannot be used in this process, for example, by means of a magnetic separator 7, the decomposed dry products are finely ground in a fine mill 8 and once again moistened with water, into which surface-active substances may be incorporated, by means of a spray nozzle 9 over a conveyor belt and then shot off the end of the said belt, so that the particles or conglomerates of the product fall down loosely. Binders are now sprayed by means of a spraying assembly 10 onto these particles which are descending freely. This operation is followed by mixing in a mixing drum 11. Finally, the entire product is compressed at a pressing station 12 into elements which are for example in the form of sheets or blocks. After the curing or drying operation, the pressed components are available as completed elements for further use, more particularly in the building industry.

Indicated hereafter are a number of Examples describing the last processing steps of a process within the invention, in which the "prepared refuse" has already been decomposed with quicklime and possibly has again been provided with water, to which surface-active substances are added. The last-mentioned procedure is particularly recommended when polymer dispersions are used as binder.

Example 1

50 parts of refuse which had been prepared or decomposed with CaO were mixed with 10 parts of a polyepoxide compound of pentaerythritol and epichlorhydrin, which contains 3.8 parts of 4,4'-diamino-3,3'-dimethyldicyclohexylmethane in homogeneous distribution, and 3 parts of water, in an intensive mixer. After a mixing time of 4 minutes, the mass as thus produced was introduced into hollow block moulds, from which building elements were removed after 4 hours. The compressive strength was 28 Kp/cm^2 and the weight per unit volume 340 Kp/m^3.

Example 2

50 parts of decomposed refuse, which had been sprayed with 20 parts of water containing 2 parts of wetting agent based on alkyl phenol with 10 mols of ethylene oxide, were thereafter impregnated with a mixture of 20 parts of polymer dispersions, consisting of vinyl propionate and vinyl chloride, and 10 parts of a condensation resin of 1 mol of urea and 2.3 mols of formaldehyde

and 20 parts of water. In a drying oven, a building element was pressed at 90 to 100°C and drying took place. The plates had a thickness of 20 to 25 mm and a weight per unit volume of 100 to 120 kp/m³. They can be used as facades, insulating boards or combined insulating and building boards.

Example 3

50 parts of decomposed refuse were mixed with 15 parts of an unsaturated polyester resin with a styrene content of 25% having a viscosity of 6000 cP and 6.2 parts of 50% tert.-butyl perbenzoate. The mixture was introduced into a mould and consolidated by shaking over a period of 60 seconds; and pressure applied for smoothing the surface. Hardening took place at 150°C. The partitioning elements or wall elements produced have a weight per unit volume of 400 kp/m³ and a compressive strength of 100 kp/m².

Example 4

50 parts of prepared refuse which had been decomposed with CaO were intimately mixed with 30 parts of sand (grain size 0 - 3 mm) and 20 parts of cement with addition of water and shaped in a press to form building elements. Synthetic plastic dispersions can be added to the water.

The building elements produced by the above-described processes are for example hollow block bricks, wall panels, false ceilings, partitioning elements, insulating boards, facades, but can also be boards which can be walked upon. It is also possible for the building elements to be produced directly at the place of use in the form of road surfaces and included in the present invention is a pouring procedure, as with conventional tar or bitumen road surfaces, by which the material is consolidated and solidified after the pouring operation by rolling.

WHAT I CLAIM IS:—

1. A process for the production of a building element from waste material as hereinbefore defined, in which the waste material is comminuted, mixed with a substance which in the mixture is alkaline, and at least partially dehydrated, and the decomposed material thus produced is mixed with a binder and compressed to form a building element.

2. A process according to claim 1 wherein the waste material is mixed with the substance which is alkaline in the mixture after comminution.

3. A process according to claim 1 or claim 2 wherein one or more strong alkalis or substances which give strong alkalis in the mixture are used as the substance which is alkaline in the mixture.

4. A process according to claim 3 wherein the strong alkali is quicklime, which acts at least partially to dehydrate the waste material.

5. A process according to claim 4 wherein the quicklime is added in excess of the amount required fully to dehydrate the waste material.

6. A process according to any one of the preceding claims wherein heat is supplied to the said mixture consisting of waste material and the substance which is alkaline in the mixture.

7. A process according to any one of the preceding claims wherein the decomposed material is sprayed with the binder while descending freely in loose form.

8. A process according to any one of the preceding claims wherein the decomposed material is moistened prior to the mixing with blunder.

9. A process according to claim 8 wherein the moistening is with water which contains a surface-active substance.

10. A process according to any one of the preceding claims wherein a hydraulically active binder is added.

11. A process according to any one of the preceding claims wherein a sterilising agent or disinfectant is added to the waste material.

12. A process according to any one of the preceding claims wherein decomposed material is separated from other material remaining in the mixture before compression into a building element.

13. A process according to any one of the preceding claims wherein the material is compressed to form a building element with drying or curing.

14. A process according to any one of claims 1 to 12 wherein the material is poured and pressed to form a building element *in situ*.

15. A process according to claim 1 substantially as herein described with reference to the accompanying drawing or as described in any one of the Examples.

16. A building element whenever produced by a process as claimed in any one of the preceding claims.

MEWBURN ELLIS & CO.
Chartered Patent Agents

70/72 Chancery Lane

London W.C.2.

Agents for the Applicant

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1 SHEET

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.